

Dengue fever in Punjab, Pakistan: Knowledge, perception and adaptation among urban adults



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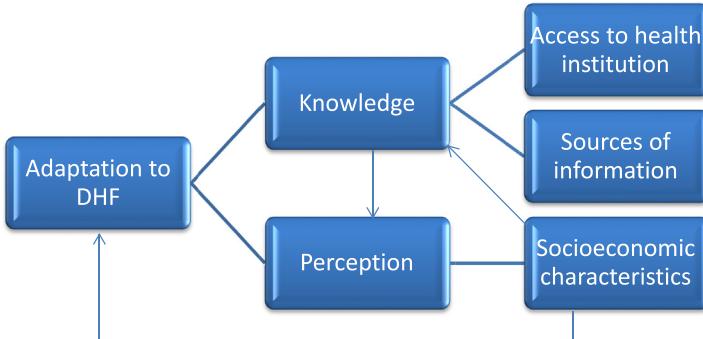
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HIGHLIGHTS

- Electronic and print media were important in generating awareness on dengue fever among the masses
- High perception level was reported by affected respondents 46% respondents that did not suffer from dengue fever compared to 57% of the respondents who suffered from it
- The respondents that suffered from dengue fever were more probable of adaptation to dengue fever
- Education, income, family size and perception were crucial factors in adaptation to dengue fever

GRAPHICAL ABSTRACT

Flow chart of adaptation to dengue fever.



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ABSTRACT

Climate change and weather variations are strongly associated with the incidence of dengue fever, outbreak risk in Pakistan and other developing countries. Knowledge and adaptation measures can affect the incidence and outbreak risk of dengue fever. The present study attempted to determine the knowledge, perception and adaptation to dengue fever by the respondents in Faisalabad, Pakistan employing cross-sectional data. The respondents who suffered and those that did not suffer from dengue fever have reported that electronic and print media were important sources of awareness about dengue fever. Around 59% respondents who did not suffer from dengue fever reported knowledge of being affected by dengue fever and 67% did not perceive that the symptoms of dengue fever would appear after mosquito biting. Logit model was employed to examine the factors affecting the adaptation measures to reduce the incidence of dengue fever. Education, family size, adults, income and perception were significantly related adaptation to dengue fever. The respondents that suffered from dengue fever were highly probable to use the adaptation measures compared to the respondents that did not suffer from dengue fever. Findings of the study might be helpful for the public health authorities to devise policies on improving awareness of dengue fever among the masses and sensitizing population to use adaptation measures.

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1. Introduction

Infectious viral diseases are considered more challenging than terrorist threats in the world as the losses from the diseases are far higher and long lasting. These diseases pose a serious threat to human health and economic development especially in the developing countries, since people have limited and or no access to basic health facilities, in

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addition to very low per capita income. Such diseases increase financial burden on the governments and people as well. Dengue Haemorrhagic Fever (DHF) is among the infectious viral diseases. DHF is the disease of the tropics transmitted by striped *Aedes aegypti* mosquitoes (Hafeez et al., 2012). It is an endemic in 112 countries (Pinheiro and Corber, 1997) including Pakistan. Every year 21,000 children reportedly die due to DHF (Murugan et al., 2007), resulting in massive human misery, mortality and economic costs (Guzman and Istúriz, 2010).

In addition to other factors, climate change and weather variations can contribute in the outbreak risk of DHF. Morin et al. (2013), Banu et al. (2014) and Ebi and Nealon (2016) argue that climate change and weather variations are associated in the spread of the *Aedes* mosquitos and DHF through multiple mechanisms. High precipitation with suitable temperature is strongly linked with the risk of DHF. Humidity and vapor pressure also cause the spread of DHF (Bhatt et al., 2013; Estallo et al., 2015). Urban and peri-urban centers are highly vulnerable to the risk of DHF because of the widespread poverty and poor economic and health infrastructure. Further, vagaries of climate change increase the misery of urban and peri-urban dwellers. Climatic and weather variations in the presence of urbanization are associated with high incidence and outbreak of dengue. Dengue ecology, lengthening and the duration of vector activity and infectious period are highly related to the changes in climate (Morin et al., 2013). In addition to climate change, minimum, maximum and mean temperature, humidity and wind velocity are also strong predictor of outbreak risk of DHF, depending on the local weather context (Morin et al., 2013). Climate change and weather variations together with rising population in the urban centers cause havoc in the developing countries. Incidence and outbreak of DHF occurs in South Asia, especially in Sri Lanka, India, Bangladesh and Pakistan. In Pakistan, its outbreaks are reported in different years, such as 1994, 1995, 1997, 2006 and 2007. However, outbreak of DHF during the end of the last decade caused the major threat to human health in Punjab (Sajid et al., 2012). Its wide spread in many districts of Punjab, Pakistan resulted in many mortality and morbidity cases.

Associated high morbidity and mortality cost necessitates the need to devise national plan to be implemented on emergent basis in Pakistan (Butt, 2010). Considering the severity level of DHF, various measures were taken by the public sector administration. Those measures include providing information on DHF recognition, helping suspected cases, fumigating and fogging by spraying teams. Intensive awareness programs were launched among the masses employing different sources, such as electronic and print media. However, there may be people having different perception of DHF and preventing measures as well. Lack of knowledge on preventive measures can affect the efforts of public sector programs to control or reduce the risk of DHF. There is very little evidence available regarding level of knowledge, perception and adoption of preventive measures relating to DHF (Itrat et al., 2008) and other climate related extreme events such as heat waves (Bakhsh et al., 2016; Rauf et al., 2017; Bakhsh et al., 2018) among the masses. This study is designed to bridge this information gap as it has determined knowledge, perception, and the adaptation measures to dengue fever. Specific objectives are to determine the level of knowledge and perception of dengue fever among the population and to examine the extent of adapt of preventive measures used by the respondents. Knowledge on DHF and precautionary measures is important for developing policy to overcome DHF from the country. Rest of the paper is structured as: Section 2 includes materials and method, Section 3 describes results followed by Discussion section. The last section concludes the study and provides policy suggestions.

2. Materials and methods

2.1. Data and source

Densely populated cities of Pakistan like Faisalabad are highly vulnerable to DHF. Faisalabad is the third largest city of Pakistan with a

population of above seven million people. DHF spread widely in Faisalabad and killing over 300 people and infecting >14,000 individuals in 2011 in only two big cities including Faisalabad (The Nation, 2012). The present study was thus conducted in District Faisalabad, Punjab, Pakistan. It is an industrial city where 42.7% people live in urban area and the remaining 57.3% population is the resident of rural area (Government of Punjab, 2012). Health facilities are not enough as there are only five public hospitals with <1000 beds capacity.

Cross-sectional data was collected in 2014 using well-structured and pre-tested questionnaire containing information on knowledge, perception and adoption of preventive measures, in addition to usual socio-economic characteristics. The sample of 150 respondents was taken employing cluster random sampling technique by dividing population into households with at least one family member infected by DHF and households having no family member infected by DHF. For the first type of households, we obtained the information from various hospitals with special arrangement of treating patients with DHF in Faisalabad city. The record available with the hospitals contained addresses and contact numbers of the patients. This information was used to prepare the list of the affected households. From this list, 21 DHF patients were selected randomly. Second type of cluster included those households with no family affected by DHF. A total of 129 households were taken from the locality/area where households with DHF patients were located. At least 6 households were selected from one locality near the households affected by DHF. From each selected household, one adult member was asked to provide information contained in the questionnaire. Although sample size doesn't represent whole Pakistan and was moderate sample from the largest city of Punjab Pakistan, however, it was enough to reveal the picture of knowledge, perception and practices of the individuals in the study area.¹ Recent available literature on knowledge, perception and adaptation (see for example, Rauf et al., 2017; Green, 1991; Algina and Olejnik, 2003) support the use of small sample if it becomes hard to avail larger sample size. Further, characteristics of many cities of Pakistan are similar to Faisalabad. Findings of the study provide useful insights on attitude and behavior of individuals in relation to DHF for many densely populated cities of Pakistan in particular and developing countries in general.

First, we selected the households and got the verbal consent of the head of the households before the survey. The households were briefly informed about the purpose and scope of the study. The survey team also briefed that the study would not provide any monetary benefits to the households either before or after the survey. Confidentiality of information was ensured to the households and the sole purpose of the information used for the research purpose was explained in detail.

After obtaining the consent from the heads of households, we selected the respondents from households. Since questionnaire was prepared in English and though we were having translated copies in national language, however, literacy rate in the study area is very low, the interviewers asked the questions in the national language of Pakistan. Each filled questionnaire was cross-checked and edited by the postgraduate student on the same day at the end of interview. Care was taken to confirm the accuracy and uniformity of the data in order to avoid approaching the respondents for the missing/incomplete information. Additionally, we have asked the respondents to provide information on the adapted preventive measures to DHF. This was done using 16 statements. Adaptation score was assessed by adding scores of all statements. A score of one was assigned to 'don't know' response, two for 'no' and three for 'yes' response for each statement. Total score of all statements was categorized at mid-point into high adaptation and low adaptation.

2.2. Empirical method

We used logit model to determine factors affecting adaption of preventive measures relating to DHF. The dependent variable is binary in

¹ We are highly thankful of the Reviewer for the valuable guidance about this point.

logit model. The logit model can be written as;

$$P_i = \text{Prob}(Y_i = 1) = F(\hat{\beta}X_i) = \frac{1}{1 + e^{-Z_i}} \quad (1)$$

$$1 - P_i = \text{Prob}(Y_i = 0) = 1 - F(\hat{\beta}X_i) = e^{Z_i} / (1 + e^{Z_i}) \quad (2)$$

$$\frac{P_i}{1 - P_i} = e^{Z_i} \quad (3)$$

$$\ln \left[\frac{P_i}{1 - P_i} \right] = Z_i \quad (4)$$

where P_i is the observed response for i -th observation. This means that $Y_i = 1$ shows the presence of particular outcome and $Y_i = 0$ is the indication of absence of particular response outcome. X_i is the vector of explanatory variables influencing occurrence of outcome variable (P_i). The odd ratio of presence of outcome to absence of outcome is represented by $\left[\frac{P_i}{1 - P_i} \right]$. After taking log of odd-ratio, we obtain logistic form i.e. Z_i . Value of Z_i ranges from negative infinity to positive infinity and it is log linear function of explanatory variables. Following econometric form of logit model is used:

$$Z_i = \beta_0 + \beta_i \sum X_i + \mu_i \quad (5)$$

where β_0 shows intercept of the model, β_i indicates change in logistic by one unit change in independent variables, X_i . The change in occurrence of probability of outcome to a unit change in independent variable can be estimated as

$$\frac{\partial P}{\partial X_i} = \beta_i [P_i(1 - P_i)] \quad (6)$$

Maximum likelihood method has been used to estimate the logit model parameters. A dichotomous form of the variable "adaptation to DHF" was taken as the dependent variable. The respondents were categorized as the high adapters or the low adapters to DHF. We assign the value of 1 for high adapters and else zero. Explanatory variables include age of the respondents, education of the respondents, family size, number of male adults, head of households, monthly income, dummy for the respondents that suffered from DHF, perception and interaction term of perception and education. **Table 1** shows definition and descriptive statistics of the variables of the logit model.

3. Results

3.1. Socioeconomic characteristics

Socioeconomic characteristics of the respondents that are given in **Table 1** show that the mean age of those suffered from DHF was 32.29 years and age of those who did not suffer from DHF was 27.72 years. Family size of the respondents that suffered from DHF

was 6.10 and family size of other category was 6.12. Male adults in the respective group were 3.43 and 3.32. Most respondents who suffered from DHF were not the head of households (58%) and this percentage was 83% among the respondents who did not suffer from DHF. The mean schooling years of respondents were 10.90 and 14.00 years respectively for those who suffered from DHF and those who were not patients of DHF. Monthly income of the respondents suffered from DHF was US\$ 287.78 and those who didn't suffer from DHF reported US \$275.09. Out of total respondents who suffered from DHF, 17 respondents were hardly hit from DHF and four respondents reported minor attack of DHF. Perception and adaptation levels among respondents were categorized into low and high (for details, see [Rauf et al., 2017](#)). We found that those who suffered from DHF have low level of perception and adaptation as 43% were found having high level of perception compared to 76.7% of those who did not suffer from DHF. Similarly 33% of those who suffered from DHF were found high adaptors of DHF compared to 67% of high adapters to Dengue Fever among those who did not suffer from DHF. This indicates that high perception level leads to higher adaptation to DHF.

3.2. Knowledge of DHF among the respondents

People build their perception and take appropriate decision to reduce the risk of exposure to different health problems. DHF is among such health problems when the population consider preventive measures based on the knowledge and perception. Thus, the role of knowledge in building perception regarding DHF is important. People with good perception are assumed to adopt preventive measures. After widespread of DHF in Punjab province of Pakistan, various sources were used to spread the information among the masses in order to reduce the vulnerability of people from DHF. The present study was designed to see the role of various information sources relating to DHF. We found six major sources of information for knowledge on DHF among the respondents. They included friends/relatives, radio/TV, newspapers, wall-chalking/posters, seminars/workshops and internet. **Fig. 1** shows comparison of source of knowledge between those that suffered from DHF and those who did not suffer from DHF. TV/radio was found to be the main source of knowledge on DHF among the respondents (71.4% and 65.9% for those that suffered and did not suffer from DHF respectively). Friends/relatives as the source of knowledge on DHF were reported by above 30% respondents from both groups. Newspapers also contributed substantially in providing information on DHF to the masses and 42% of respondents that did not suffer from DHF reported this source of knowledge and this percentage was around 24% among respondents who faced DHF. Other important sources of information on the descending order were walk-chalking/posters, seminars/workshops, and internet among the respondents who suffered from DHF whereas the other major sources of information for those who did not suffer from DHF were wall-chalking/posters, seminars/workshops, and internet.

Among the respondents who suffered from DHF, 71.4% were of the view that everybody had an equal chance to be affected by DHF, whereas 14.3% respondents believed that everybody had not equal

Table 1

Socioeconomic characteristics of the respondents.

Socioeconomic characteristics	Overall sample	Respondents that suffered from DHF	Respondents that did not suffer from DHF
Age of the respondents (year)	28.36 (10.34)	32.29 (13.48)	27.72 (9.66)
Years of schooling (year)	13.57 (4.81)	10.90 (5.86)	14.00 (4.49)
Family size (no.)	6.11 (1.98)	6.10 (1.81)	6.12 (2.01)
Number of males (no.)	3.13 (1.38)	3.43 (1.66)	3.32 (1.64)
Household head (1 = yes)	0.21 (0.41)	0.42 (0.51)	0.17 (0.38)
Monthly income (US\$)	261.39 (165.84)	287.78 (216.26)	257.09 (156.76)
Those suffered from DHF (1 = yes)	0.14 (0.34)	0.43 (0.51)	0.54 (0.50)
Perception level (1 = high)	0.48 (0.40)	0.33 (0.42)	0.67 (0.38)
Adaptation level (1 = high)	0.29 (0.46)		

Figures in parentheses are percentage.

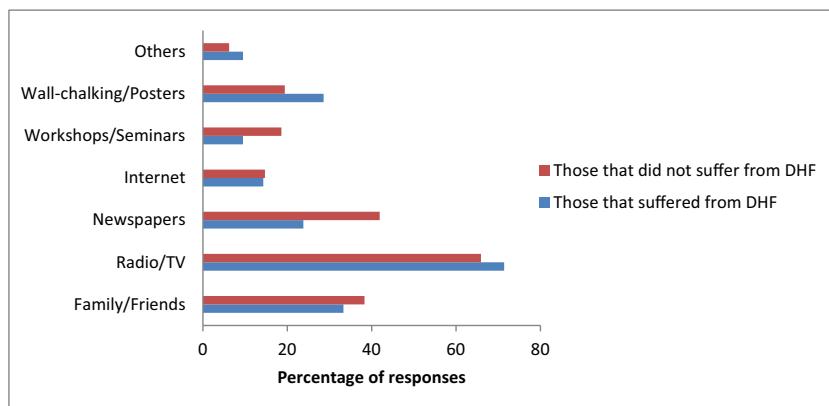


Fig. 1. Sources of information on dengue fever. * Multiple responses were there so percentage may be >100%.

probability of being sick by DHF. Considering the respondents who were not affected by DHF, 58.9% showed their concern relating to “everybody has an equal chance to be affected by DHF” and those who did not favor this statement were 25.6%. There were 5.4% respondents who reported that they didn’t know whether DHF would affect all persons equally or not (Fig. 2).

Fig. 3 shows information on symptoms of DHF reported by the respondents. Fever, eye pain, headache, widespread rash, nausea/vomiting, muscle/joint pain, bleeding from nose or gum were the main symptoms reported by the respondents who suffered from DHF. Regarding the respondents who did not suffer from DHF, they reported that fever (77.5%), headache (57.4%), eye pain (38%), muscle/body pain (32.6%), widespread body rashes (39.5%), nausea/vomiting (33.3%) and nose/gum bleeding (24.8%) were possible symptoms of DHF whereas 9.3% respondents didn’t know about any symptom of DHF. The same symptoms were reported by the counterpart group as well.

Vulnerability to DHF can be avoided by using preventive measures. We asked the respondents whether they had knowledge of preventive measures relating to DHF. Fig. 4 shows preventive measures reported by the respondents. Majority of the respondents who suffered from DHF reported different measures. Those measures included discarding unused or extra water (66.7%), discarding old types (23.8%), spraying insecticide (61.9%), using bed nets (47.6%), inspecting and removing stagnant water from AC/room cooler (38.1%) and drying water from grassy plot or garden (9.5%). The main measures used by those who did not suffer from DHF were discarding unused or extra water (61.2%), discarding old tires, trash (41.9%), using insecticide spray (49.6%), using bed nets (42.6%), inspecting and removing stagnant water from AC/room cooler (27.1%), drying water from garden or grassy plot (31%) and wearing full sleeves/covering body (21.7%).

The respondents were enquired about the extent of severity of DHF on human health. Fig. 5 shows information regarding level of concerns relating to DHF. The respondents that suffered from DHF were asked to provide information on the extent of concerns relating to DHF on their health. Among the respondents, 52.4% were extremely concerned about their health due to expected outbreak of DHF, 28.6% were very concerned and 19% were fairly concerned about the effects of DHF on their health. Similarly, respondents that did not suffer from DHF also report their concerns related DHF effects on their health. Those who reported extreme concerns of DHF on their health were 42.6% and 7% reported no concern of DHF on human health. Fairly concerned and very concerned responses were reported by 24.8 and 25.6% respondents, respectively.

3.3. Perception of the respondents to DHF

The study examined perception of respondents to DHF and results are reported in Table 2. The respondents from both groups were aware of the mode of transmission of DHF as reported by 33.3% of those that suffered from DHF and 42.1% of respondents who did not suffer from DHF. The remaining respondents reported that they were not aware of the mode of transmission. We asked the respondents whether rainy season was good for DHF spread. Around 42% and 40% respondents from respective group favoured the statement. Among those who agreed to finish the treatment fully for DHF were 35.7% of those that suffered from DHF. This percentage was only 24% among those who did not suffer from DHF. Perception of respondents relating to infectious disease was enquired using statement “Do you need to worry if one of your family members was diagnosed as Dengue Fever patient and it increases probability to have impact on other family members?” We

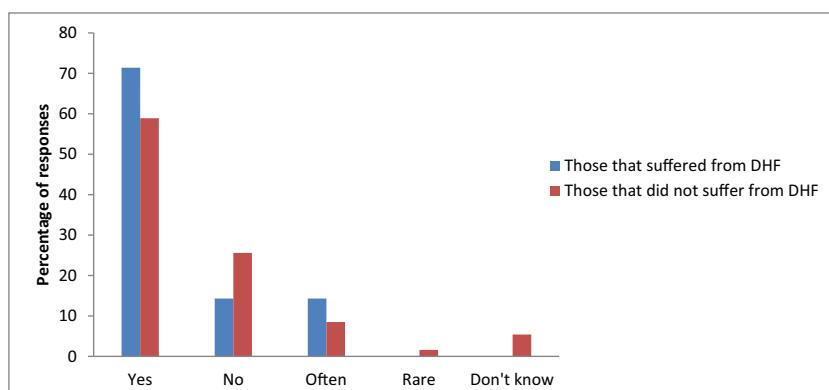


Fig. 2. Response of the respondents on the chances of individuals to be infected by DHF.

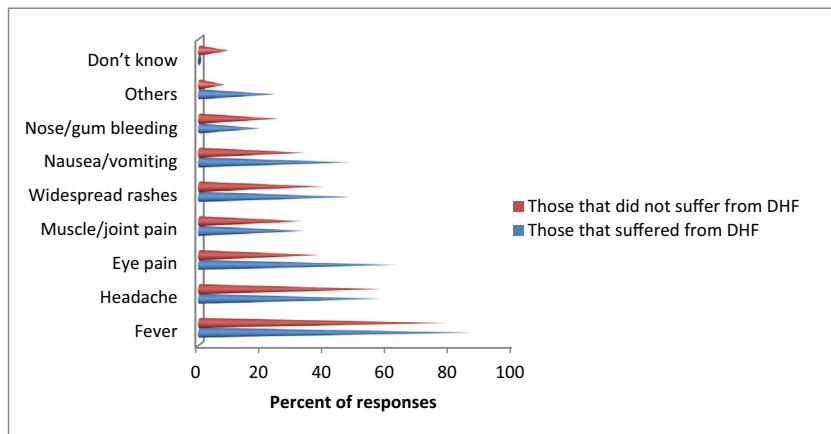


Fig. 3. Information on symptoms of dengue fever among the respondents. Due to multiple responses, percentage may be >100%.

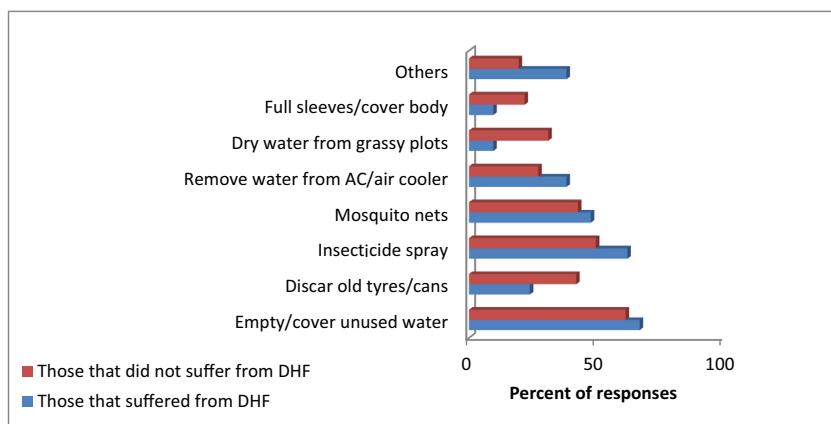


Fig. 4. Information on preventive measures of dengue fever among the respondents.

found alarming response from the respondents as 29.2 and 16.7% respondents from the respective groups considered it as an infectious disease while majority of the respondents reported that they did not know or they did not consider it as an endemic disease.

3.4. Adaptation to dengue fever

DHF is an endemic disease and risk can be avoided by adapting various measures. The respondents reported different types of adaptation to DHF (Table 3). Considering diet, 100% respondents suffered from DHF reported that diet in the form of juices and liquid should be used

frequently and 77.8% of those who did not suffer from DHF were aware of juices and other liquid to be used for curing endemic disease. Covering water containers during biting time was reported by 75% respondents suffered from DHF and 69.8% respondents that did not suffer from DHF. Percentage of the respondents covering themselves during the time of mosquito biting was 83.3 and 57.9% respectively. Covering body using full sleeved tops, full length pants, socks and shoes are possible measures to escape mosquito bites. The role of media was enquired by asking the respondents to response the statement “Listen to media awareness about DHF” and it was found that 70.8% respondents that suffered from DHF reported the role of media in building awareness

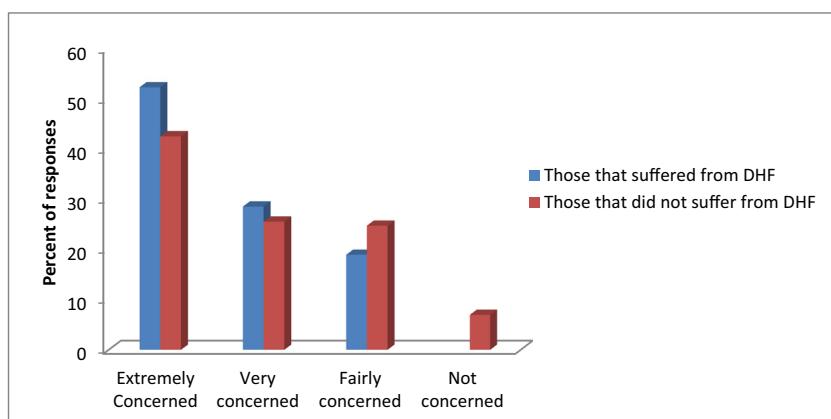


Fig. 5. Extent of personal concerns about dengue fever among the respondents.

Table 2
Perception of the respondents relating to dengue fever.

Perception	(Percentage)					
	Respondents that suffered from DHF			Respondents that did not suffer from DHF		
	Yes	No	Don't know	Yes	No	Don't know
Do you know how DHF is transmitted?	33.3	57.1	9.5	42.1	10.7	9.8
Do you know that DHF symptoms appear after biting of mosquitoes?	12.3	9.3	12.3	33.2	66.5	9.3
Extent of your concern about the effects of DHF on you personally?	83.3	0	16.7	57.9	27	15.1
The elders and children are the only ones vulnerable to dengue fever?	29.2	20.8	50	16.7	15.9	67.5
Is it needed to finish the treatment fully for DHF?	35.7	33.3	29.2	23.8	20.6	55.6
Fogging by the municipal council is enough for protection from dengue?	43.7	17.8	37.5	35.7	40.5	23.8
Do you need to worry if one of your family members was diagnosed as dengue fever patient and it increases probability to have impact on other family members?	29.2	20.8	5.5	16.7	15.9	67.5

Table 3
Adaptation to dengue fever by the respondents.

Adaptation to dengue fever	(Percentage)					
	Respondents that suffered from DHF			Respondents that did not suffer from DHF		
	Yes	No	Don't know	Yes	No	Don't know
Drink plenty of juices/liquids	100	0	0	77.8	15.1	7.1
Cover open water containers/pipes in your house	75	8.3	16.7	69.8	30.2	0
Cover yourself when mosquito biting is expected	83.3	0	16.7	57.9	27	15.1
Listen to media awareness about dengue fever	70.8	16.7	12.5	34.1	54	11.9
Use bed nets as preventive measures	35.7	33.3	29.2	23.8	20.6	55.6
Buy medicines without prescription while suspecting symptoms of DHF	29.2	20.8	50	16.7	15.9	67.5
Inspect refrigerator tray for standing water	45.8	37.5	16.7	41.3	23.8	34.9
Examine mosquito larvae in house	45.8	37.5	16.7	41.3	23.8	34.9
Examine mosquito larvae outdoor	25	41.7	33.3	19	21.4	59.5
Participate in community 'clean our surroundings' activities	16.7	4.2	79.2	19	30.2	50.8
Dry standing water in air coolers, garden, etc.	41.7	20.8	37.5	40.5	35.7	23.8
Use of insecticide sprays	41.7	25	33.3	54	27.8	18.3
Use of mosquito repellents creams/lotion	58.3	8.3	33.3	50.8	32.5	16.7
Reduce shopping and other activities when insect biting is expected	41.7	16.7	41.7	30.2	30.2	39.1
Use of electric rackets, mosquito coils, electric vaporizing mats	54.2	12.5	33.3	32.5	32.5	34.9
Inspect any discarded material that holds water around your house	50	20.8	29.2	35.7	37.3	27

on DHF and this percentage was 34.1% only reported by respondents who did not suffer from DHF. The use of bed nets was reported by 35.7 and 23.8% respondents from respective groups. Buying medicine without prescription when suspecting DHF was practiced by 29.2 and 16.7% respondents among the respective groups.

Among those that suffered from DHF, 45.8% stated that they inspected refrigerator tray on regular bases, 45.8% were conscious about mosquito breeding sites and inspected these sites inside house. However, few (25%) were found inspecting breeding sites outside house. Considering those who did not suffer from DHF, 41.3% reported that they examined mosquitos inside the house and 19% respondents were found never examining mosquito larvae outdoor. In the group of respondents that suffered from DHF, we found that 58.3% respondents used mosquito repellents creams/lotion as an important measure to reduce the risk of DHF. The use of electric rackets, mosquito coils, and electric vaporizing mats were found among 54.2% respondents. Those adapting insecticide sprays were 41.7%. The second group of the respondents who did not suffer from DHF also reported the same preventive measures adopted to reduce the vulnerability. However, these percentages were lower as compared to the group of the respondents who suffered from DHF.

3.5. Factors affecting adaptation to DHF

The present study employed logit model to examine the effect of socioeconomic factors on high adaptation level among the respondents. Table 4 shows the estimates of logit model. A total of 9 explanatory

variables were included in the model and 8 variables were statistically significant. High perception level taken as explanatory variable was found significantly contributing to high level of adaptation to DHF, according to the expectation. Family size variable was negatively related with high adaptation to DHF. Coefficient of the adult male variable was positively related to high adaptation to DHF. Education of respondents was significantly contributor to high adaptation to DHF. It was also found that coefficient of dummy variable of those who suffered from DHF was negative and significant. Head of household variable

Table 4
Estimates of logit model.

Variables	Coefficient (Std. error)	Marginal effects (Std. error)
Age	-0.03 (0.25)	-0.01 (0.01)
Education	0.25*** (0.13)	0.06 (0.03)
Family size	-0.18*** (0.04)	-0.05 (0.02)
Adult males	0.65*** (0.25)	0.15 (0.06)
Household head	-1.56*** (0.61)	-0.37 (0.13)
Monthly income	0.00* (0.00)	0.00 (0.00)
Suffered from DHF	-1.57*** (0.59)	-0.37 (0.13)
Perception	5.38*** (1.86)	0.85 (0.09)
Perception * education	0.40*** (0.14)	0.09 (0.03)
Constant	-0.61 (2.08)	
Log likelihood	-43.30	
LR chi ²	45.76***	
Pseudo R ²	0.34	
Observations	150	

*** p < 0.01, ** p < 0.05, * p < 0.1.

was negatively related with high adaptation to DHF. We also introduced interaction term of high perception and education to determine the combined effect of these two variables. This interaction term was significant and positively related with high adaptation to DHF. Monthly income was significantly related with adaptation level, although, it was statistically significant at 10% probability level. For addressing the stability of the model, we also used multiple regression model taking adaptation score as the dependent variable. We found that the signs of the coefficients were almost the same and significant coefficients were less compared to the logit model (Results are provided in [Appendix 1](#)). So we reported the logit results in the present study.

4. Discussion

Economic impacts of adverse health shocks resulting from DHF outbreak or other diseases can be mitigated through health insurance. Health insurance is not present or limited to cover adverse health shocks in the developing countries, particularly, Pakistan due to one or other reasons. Among several, poverty and less awareness can be leading reasons. In the absence of health insurance, adverse health shocks result in unpaid utility bills, diversion of spending from food nutrition and education to health spending. Thus, health shocks are associated with two types of costs, namely loss of earnings and medical expenses. Further, productivity loss of accompanying person is also of great importance as it can be in the range of 13.7% to 17.8% of total health cost ([Bakhsh et al., 2017; Bakhsh et al., 2016](#)). In addition to this, with limited health facilities in public hospitals, outbreak of DHF or other diseases increase the burden on the already limited hospital resources.

Results point out that the respondents suffered from DHF were more conscious about the ill effects of DHF on their health and family members compared to those who did not suffer from DHF. Stresses of dengue fever can be felt in the everyday life at home, work place or society due to emotional attachment with the infected persons, associated high health costs of dengue fever, episodic psychological distress and irritability ([Page et al., 2007](#)). Incidence and outbreak of dengue fever can have serious implications for ensuring healthy lifestyle in a developing country context of Pakistan with weak health protection infrastructure, poor public health facilities and low per capita income.

Looking for mosquito larvae inside the house were reported by many respondents but services rendered at community level are very bleak. This indicates the lack of awareness among the masses in the study area. [Clark et al. \(2005\)](#) also found the similar findings. Similarly, we found that the respondents in the study area had very low perception on DHF. Further, small percentage of the respondents was found using the bed nets due to one or other reasons. Further, vulnerability to DHF can be avoided through using various measures such as inspecting refrigerator tray, mosquito breeding sites and discarded materials. Results are also indicative of an increasing role of print and electronic media in building knowledge and perceived adaptation to the associated health risk of dengue fever outbreak.

High perception relating to DHF was positively related with adaptation. This finding is in line to that of [Nalongsack et al. \(2009\)](#) who found that high risk perception led to high adaptation. Combined effect of education and perception shows that the likelihood of high adaptation would increase if the respondent has high perception of DHF and possessed high schooling year. [Zameer et al. \(2013\)](#) argued that level of perception and education were positively related with adaptation. We also estimated individual effect of education of the respondents on adaptation. Estimates show that education of the respondents contributes significantly to leading to high adaptation to DHF. An addition of one schooling year was associated with an increase in probability of being high adaptation by 0.15%. This result is similar to the finding of [Matta et al. \(2006\)](#). Negative and significant coefficient of family size implies that as the family size increases, probability for high adaptation decreases by 0.049%. This is due to the fact that the increased family size could increase financial burden and the household may have little

resources to adapt to DHF. [Rauf et al. \(2017\)](#) found a negative relationship between family size and adaptation to heat waves. Similar result was also found by [Jahan \(2011\)](#).

Since adaptation to DHF is costly, we considered the number of adults as proxy to the earners and found a positive effect on high adaptation. This implies that as the number of males increases in the household, the income level can be high, resulting in high adaptation to DHF. Positive relation between number of the earners and adoption of preventive measures was also reported by [Naing et al. \(2011\)](#). Negative coefficient of dummy variable for those that suffered from DHF indicates that those suffered from DHF were negatively related to high adaptation to DHF, mainly because they may had not much perception about DHF or didn't hear about it. Results of [Egger et al. \(2008\)](#) also indicate that those experiencing DHF were low adopters of preventive measures. Negatively related coefficient of head of the household shows that the head may not pay much attention to cure his/her health as he/she may have spent one third of life.

Positively related coefficient of income variable implies that with an increase in income, probability of being high adapters would increase. The respondents having good knowledge and perception find it difficult to adapt to DHF due to income constraint as adaptation practices can be costly ([Liu et al., 2013](#)). [Clark et al. \(2005\)](#) and [Rauf et al. \(2017\)](#) also found the role of income in adaptation.

5. Conclusion and policy suggestions

Reducing or overcoming the threats of DHF to human health can be realized by improving knowledge, perception and adaptation. Knowledge and perception of DHF among the masses are considered important in building capacity of people to take preventive measures. We find that electronic media, namely radio/TV plays a crucial role for improving awareness on DHF and adaptation measures. Rigorous campaign by public sector health organizations through electronic and print media yielded the desired results in the study. Findings of the present study warrant regular awareness campaign through diverse sources as it is the need of the time to educate and train the masses to achieve the ultimate objective of adaptation to DHF.

Findings of the study showed that the respondents were mainly concerned with inspecting possible sites of mosquito breeding inside the house. Involvement of community to control and inspect breeding sites of mosquito should be propagated through different sources of media, elders and religious leaders. Bed-nets were rarely used by the respondents, although bed-nets are available at reasonable prices and easy to use. This necessitates educating population to use bed-nets in order to control mosquito biting.

Factors leading to adaptation include income, education, perception, family size, adult males and head of households. An increase in income of households would enable individuals to invest in adaptation practices. Achieving the goal of adaptation to DHF is presently limited due to inadequate necessary investment in human resources, education and research. Low per capita income with little amount left after consumption expenditure highlights the need for the effective policies and measures to be taken for preparing the vulnerable population. This necessitates generating employment opportunities through encouraging firms to invest in green production practices for improving income of households. Role of perception in adaptation to DHF provides the evidence to emphasize the increased awareness of the disease, development of the early warning systems for the timely adaptation of preventive measures to be implemented. Continuously focusing on future research and development on the outbreak and distribution of DHF would help to better understand the likely distribution of DHF. These initiatives require strong coordination and access to adaptation funds to help low and middle income households prepare for changing burden of DHF. Readers are advised to read the paper bearing in mind the sample size that can be increased in future research including all

provinces of Pakistan and/or comparison can be made between different provinces.

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Appendix 1. Estimates of OLS regression

Variables	Coefficient	Std. error
Age	−0.03	0.03
Education	−0.33 ^{**}	0.16
Family size	−0.50 ^{***}	0.19
Adult males	0.55 ^{**}	0.28
Household head	−0.05	0.06
Monthly income	0.00 [*]	0.00
Suffered from DHF	−19.57 ^{***}	0.69
Perception	0.77	0.58
Perception * education	0.08 ^{**}	0.04
Constant	13.38 ^{***}	2.52
Adjusted R2	0.87	
F value	116.55 ^{***}	
Observations	150	

*** p < 0.01.

** p < 0.05.

* p < 0.1.

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